

ILLINOIS STATE GEOLOGICAL SURVEY



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POTTERY CLAY RESOURCES OF ILLINOIS

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ABSTRACT

Clays suitable for the amateur potter's use are widespread in Illinois and are easily found. This report is a guide based on the geology of Illinois for use in prospecting for new clay deposits. It describes specific types of clays and gives their locations along with notes on their plasticity and firing properties. Simple field tests for plasticity, drying characteristics, and carbonate content that are adequate to determine the usefulness of a clay for making pottery are included.

INTRODUCTION

An abundance of clay material makes Illinois good hunting ground for the amateur ceramist in search of raw materials. The several types of clays are distributed widely and complexly, and the clay within a single type of deposit may have wide variations in physical properties. Therefore, only generalized descriptions can be given here to aid a prospector determine in which areas he is most likely to find the type of clay he needs. Preliminary tests, described below, will aid in choosing a clay that has promising properties, but a real appraisal of it can be made only by actually using the clay.

The art involved in making pottery involves variations in preparing the clay, forming the ware, and in drying and firing it. Thus a variety of wares can be produced by altering one or more of the procedures. The unexploited clay resources of the state challenge the experimental potter to develop procedures that will best suit each raw material.

The large variation of properties in clays as they are found in nature can be increased still further by blending clays of different types. For example, if a deposit of clay with suitable properties is not available, it may be desirable to blend two clays in hope of developing a suitable mixture. Thus an overly plastic clay blended with a poorly plastic clay might yield a suitable material.

PRELIMINARY TESTS

In order to facilitate the search for a good pottery clay, it is advisable to determine in the field those materials which will probably prove to be useless because of poor physical characteristics. It is suggested that a representative sample for each prospective potter's clay be given three simple tests to check on plasticity, drying behavior, and carbonate content.

1) Plasticity Test

To make the plasticity test, take a sample of the clay, wet it, and work it in the hand until it has a smooth consistency. Add water slowly (to prevent over-wetting) to both dry and naturally moist clays. A clay that is deficient in plasticity will first form a crumbly mass that does not hold together. As

more water is added, it suddenly becomes liquid and will not hold its shape. Clay that is too plastic will form a sticky mass that adheres to the hands during working. Both of these types of clay are probably undesirable. Clay of the proper plasticity will form a pencil-shaped mass when rolled between the hands.

2) Drying Test

To make the drying test, form a bar approximately 6 inches by 1 inch by 1 inch from the clay after it has been moistened to the proper consistency for the plasticity test. Place the bar in the sun to dry or, if possible, in an oven at a temperature of 225°F. If the bar dries evenly without warping, spalling, or cracking, the clay has good drying properties. Observe also strength of the dried body, which is important. Some clays are crumbly when dried. In general, the firing properties can be related to plasticity and drying character. A clay that is sticky or overly plastic will probably have excessive drying shrinkage and poor firing properties which will cause the ware to warp and crack in the kiln.

3) Carbonate Test

To test the clay for its carbonate content, every prospector should carry a small bottle of dilute hydrochloric (muriatic) acid. With an eye dropper, place a drop of acid on the clay and notice any bubbling or frothing. Clays wet with acid usually show this bubbling to a degree that is in proportion to the amount of carbonate present. In general, carbonate is undesirable in a ceramic material because it may complicate the firing procedure. For example, carbonate is known to shorten the range of temperatures within which the clay will vitrify. If the carbonate occurs as grains, pebbles, or lumps, the fired ware may crack and pit in the kiln or even several days after firing. Careful firing may combat some of these difficulties but it is usually possible to find clays without carbonate, making it unnecessary to be concerned with a closely controlled firing process.

A small amount of finely divided carbonate tends to bleach red-burning clays and thus produce a variation in color which may be desirable enough to warrant the extra care and trouble in firing. This must be determined through experience.

PRELIMINARY PREPARATION

Some natural clays are virtually ready-made for the potter, as pointed out in the description of individual clay types. Others may require drying followed by crushing, sieving, rewetting, working, and some clays also need aging. For most clays, not all of these steps are necessary. It is often preferable to keep the natural moisture content of the clay until it is used, because the dry clay may produce a hard mass that would be difficult to grind.

CLAY DEPOSITS IN ILLINOIS

The term "clay" may be used geologically in a very restricted sense to designate a group of fine-grained silicate minerals. It also is used to designate

any material within an arbitrarily defined particle-size range. In this discussion the term "clay" is used to designate any natural material that could be useful to the potter regardless of its mineralogical or grain-size composition.

Illinois clay deposits can be divided into two groups, surficial and bedrock deposits. Surficial deposits are generally geologically younger than the bedrock and cover the older deposits except where streams have eroded them away or where they have been removed artificially. Surficial material is unconsolidated in contrast to the harder consolidated bedrock deposits.

Surficial Clay Deposits

Figure 1 shows the areas in Illinois in which one may expect to find an abundance of surficial clays. The map patterns indicate the broad type of the individual deposits, as shown in the key. Also shown are the approximate positions of commercial operations that are currently digging these deposits. The exact location of these pits is not difficult to obtain from people in the vicinity.

Loess

Loess, the brown to yellowish silty deposit (of wind-blown origin) that mantles a large part of the state, is the material from which many Illinois soils are formed. The deposits are easily accessible at the surface; if deeper clay is desired, it can usually be obtained in roadcuts, steep valley walls, or by digging. It is usually not necessary to grind loess much before using it for ceramic purposes as it tends to be more or less loose and powdery when dry.

Loess, where weathered, is a mixture of fine silica (quartz) and silicate particles with varying quantities of clay. Some loesses with small amounts of clay do not have desirable plastic properties for ceramics. However, the high-silica content tends to decrease shrinkage in both drying and firing. Such material often gives improved properties when combined with one of the more plastic high-clay materials. Nature has partially solved the plasticity problem by concentrating clay from the topmost layer of soil in a layer that occurs just below the soil.

That part of the loess below the weathered zone contains a variable quantity of carbonate which may not seriously affect the plasticity but which affects the firing behavior of the clay. If plasticity is to be increased, it may be done by adding clay from the weathered zone. Alluvial clays may also be added if they do not contain excessive organic matter.

Loess burns from red to light brown, depending on the quantity of carbonate and clay present. Some interesting variations in color can occur within a small volume of this material. The fired ware is generally porous and only moderately strong.

Alluvial Deposits

Alluvial deposits are those deposited by rivers or in lakes. Alluvial clays are usually silty and gray or brown. Their character may vary widely, but there is a reasonable chance of finding a suitable ceramic raw material in alluvial areas. Some of the clays are quite plastic and could be combined with



Fig. 1. - Distribution of surficial clay deposits in Illinois.

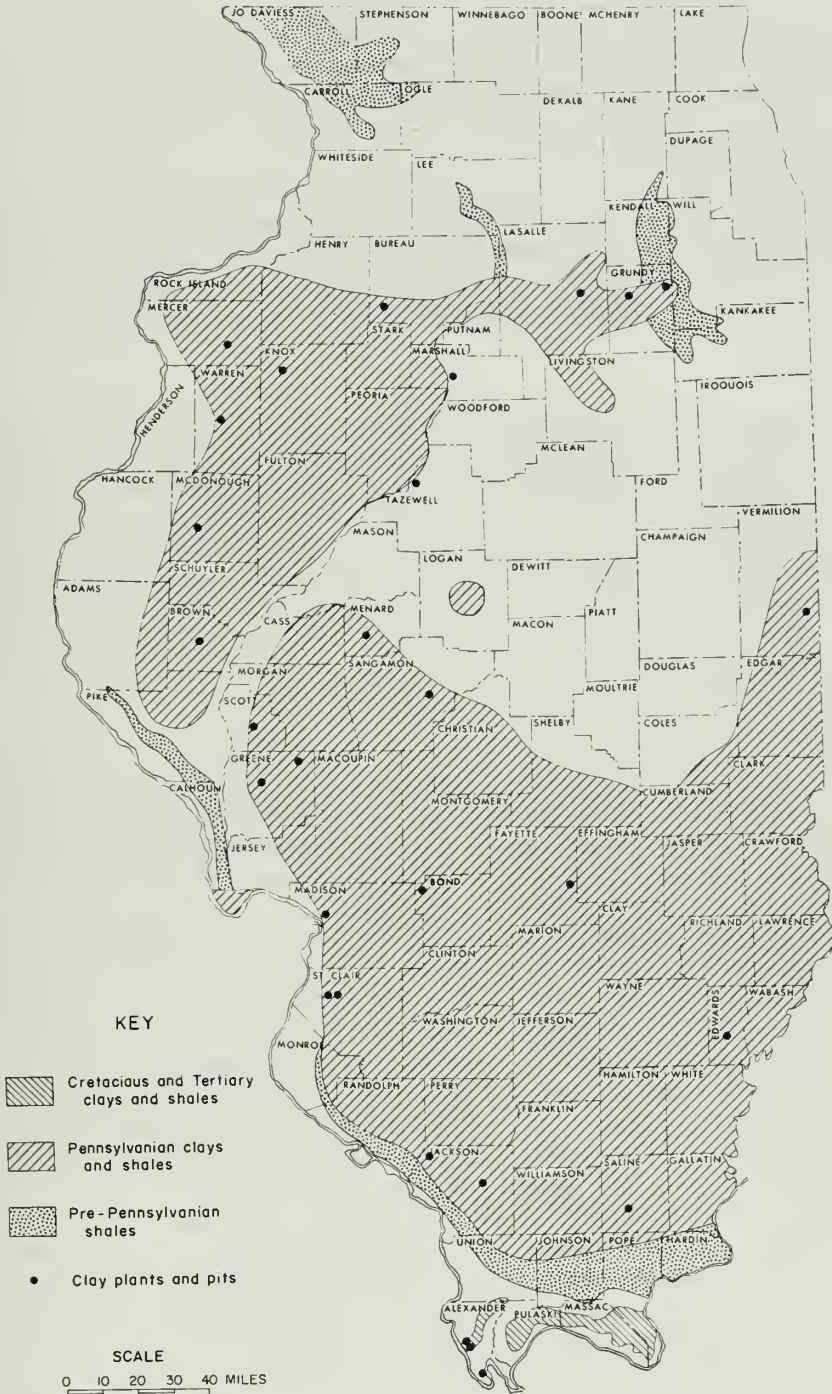


Fig. 2. - Distribution of bedrock clay deposits which crop out in Illinois.

loess. As very plastic clays generally tend to have poor drying properties, it is desirable to perform the drying test before attempting to use them. The alluvial and lake deposits (fig. 1, light dot pattern) include not only valleys of main rivers and their tributaries but also areas in which there were former rivers and lakes. Silty or clayey lake deposits have much the same ceramic characters as alluvial deposits.

Alluvial and lake clays fire red or brown and may form a denser ceramic body than loess. Some alluvial and lake clays contain carbonate, but it is normally less than is found in loess. Stream-cuts are often good sites for hunting this type of clay. It may be necessary to dry and crush the clay before using it, but in general the dried clay is not hard and is easily pulverized.

Residual Clays

Residual clays are dark red, yellow, or brown. They were formed as a result of prolonged weathering of limestone. Such materials vary in plasticity and firing properties but are usually highly colored. Residual deposits of this type develop only where a limestone layer is exposed at the surface for a relatively long geologic time. Such conditions exist in Illinois mainly outside the glacial drift border in northwest Illinois, Calhoun and Pike counties in western Illinois, and in the southern Illinois Ozarks. It is difficult to find residual clays because they are usually covered by loess. The best places to hunt are along valley walls above limestone.

Glacial Till

Glacial till covers most of the state, and in turn most of it is covered by loess deposits as shown on figure 1. The greater part of Jo Daviess and Calhoun counties and extreme southern Illinois (outside the heavy dashed line on fig. 1) are areas which contain no glacial till but are mantled by a considerable thickness of loess that lies on bedrock.

Till is a heterogeneous deposit of clay, silt, sand, pebbles, and boulders. Wherever glacial till is exposed to weathering the upper portion has been leached of carbonate; that below still contains carbonate. Loess deposits are absent or quite thin in eastern Illinois. In such places, the loess has a weathered zone from which carbonate has been removed, and clay has been concentrated just below the soil. Most glacial till will have to be sieved to remove pebbles before it can be worked. It will have to be fired carefully to avoid the detrimental effect of carbonate, if any is present. Till can be obtained by shallow digging in those areas shown on figure 1 as having thin loess, and in road-cuts, railway cuts, and walls of stream valleys in the remainder of the state. Strip coal mines uncover large quantities of glacial till in their operations.

Glacial till burns from red to light tan, depending on the percentage of carbonate and clay present. The fired ware will usually be denser than that made from loess because of the higher clay content in the till. If the till contains calcium carbonate, the same precautions will have to be taken as for loess. It must be remembered that the ceramic properties of till may change rapidly within short distances.

Bedrock Deposits

The second large category of sediments which contain suitable pottery clays is the bedrock deposits which include clays and shales. These strata occur from a foot or less up to a few hundred feet thick. Figure 2 shows areas where bedrock deposits are likely to crop out along stream valley walls, road-cuts and railroad cuts, or by other excavations. The approximate positions of commercial operations that are currently digging clays and shales are shown by dots. Geologic names used to designate strata or groups of strata are shown in the legend and used in the descriptions. Because of the overlying surficial deposits, outcrops of clay and shale are not continuous, and this must be borne in mind when examining figure 2 which shows continuous areas.

Cretaceous-Tertiary Clays

Cretaceous-Tertiary clays are found mostly in extreme southern Illinois north of the Ohio River. A great many small pits have been dug and abandoned through the years so that it should be easy to get local information about accessible clay. Some of the clays are white, refractory, burn to a light color, and have moderate plasticity. Their sand content varies within wide limits. Some of the more plastic clays tend to have a high drying shrinkage.

Pennsylvanian Sediments

Pennsylvanian sediments (fig. 2) are characterized by coals, clays, shales, limestones, and sandstones. Two of these sediments are useful as potter's clays; one is a shale which usually lies above the coal and the other is a clay known as an underclay or fireclay which lies below the coal. Above the coal in many places is a hard black shale which is not a good pottery clay. Above this, and often separated from it by a thin limestone layer, is another shale which in places attains thicknesses of a few feet to as much as 50 feet or more. In a few places a shale may also be found below the underclay and resting on top of a sandstone. This shale is usually thin, ranging up to about 10 feet thick. Some form of pulverization may be necessary to prepare this material.

Over a wide area of Illinois, Pennsylvanian shale has been used extensively in the production of red brick and tile. Its ceramic properties range widely from high plasticity and high shrinkage to low plasticity and low shrinkage. The plastic and shrinkage properties of shales are usually determined by their quartz content. The quartz content also determines to some extent their firing range and temperature. Some shales contain calcium carbonate, which occurs either as nodules or fossils, or it may be finely disseminated throughout the shale mass. These shales would have to be fired with care. In a few places in western Illinois some of the thin shales are light-burning because of their high kaolinite content, but most of the shales burn red.

The underclay beneath most coals has fair plastic properties but sometimes may contain an appreciable quantity of sand. These clays are usually more plastic at the top and less plastic near the base, because of an increase in sand content from the top to the base. The firing properties of the underclays vary from high shrinkage to low shrinkage and the fired color from red

to white or very light gray. The clays above the No. 2 coal are usually calcareous in the lower part. The noncalcareous upper part usually burns red but the calcareous lower part may burn red or some lighter color, depending on the calcium-to-iron ratio. The calcium carbonate usually is finely disseminated and occurs as nodules. One disadvantage of the clay above No. 2 coal lies in its carbonate content, which causes all of the associated firing difficulties described under loess.

On the other hand, the clays below the No. 2 coal usually do not contain carbonate and usually are light burning, but the colors may vary - reds, browns, pinks, tans, creams, salmons, grays, buffs, and white. The light-burning clays are usually found around the margin of the Pennsylvanian deposits. Some of these clays are refractory and are used commercially for firebrick. If weathered, the underclays should require but little grinding in order to form a plastic mass in water. It is often possible to dig the clay in a natural wet plastic condition and preserve the moisture until it is worked. As coal deposits are so widely mined in Illinois, this clay can be easily found at any open pit or shaft mine where large quantities of clay are exposed when coal is removed.

Kinderhook, Chester, and Maquoketa Shales

Kinderhook, Chester, and Maquoketa shales are all interbedded with limestones and sandstones of various thicknesses. Generally a moderately thick layer of fairly pure shale can be found within any part of the mapped areas. Care must be taken to determine carbonate, which is frequently a major constituent of these shales. The color of the shales ranges from dark gray to brown, green, red, and purple. They generally burn red in an oxidizing atmosphere. These shales probably will require grinding before plasticity can be developed.

SUMMARY

The two maps show that areas suitable for prospecting for ceramic clays are fairly well distributed over Illinois. Many areas have several types of pottery clay from which to choose. Many good pottery clays in limited deposits have not been developed commercially, but would be ideal for the amateur potter to use.

More detailed information on the location of outcrops of clay or shale in restricted areas can be obtained, on request, from the Illinois State Geological Survey, Urbana.



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